SEXUAL SELECTION AND BIRD SONG.

BY CHAUNCEY J. HAWKINS.

THE place of song in the life of the bird has since the days of Darwin been a question of dispute between the scientists. Darwin was the first to deal with bird song in a satisfactory philosophical manner. He formulated the theory of sexual selection which down to the present day is still held by many ornithologists to be the most satisfactory explanation of the use of song as well as the best explanation of its evolution. He maintained that the males possessing the best song would naturally be the choice of the females; and that the song characteristics which had made a male the choice of his mate would naturally be handed on to his offspring, in other words, would become secondary sexual characters. This Darwin called sexual selection in distinction to natural selection whose operation had a wider scope.

To do Darwin justice we should state the theory in his own language; Sexual selection "depends on the advantage which certain individuals have over others of the same sex and species solely in respect of reproduction."....In cases where "the males have acquired their present structure, not from having transmitted this advantage to their male offspring alone, sexual selection must have come into action."...."A slight degree of variability, leading to some advantage, however slight, in reiterated deadly contests, would suffice for the work of sexual selection."....So too, on the other hand, the females "have, by a long selection of the more attractive males, added to their beauty or other attractive qualities."...."If any man can in a short time give elegant carriage and beauty to his bantams, according to his standard of beauty, I can see no reason to doubt that female birds, by selecting during thousands of generations the most melodious or beautiful males, according to their standard of beauty, might produce a marked effect." "It has been shown that the largest number of vigorous offspring will be reared from the pairing of the strongest and best armed males, victorious in contests over other males, with the

most vigorous and best nourished females, which are the first to breed in the spring. If such females select the more attractive, and at the same time vigorous males, they will rear a larger number of offspring than the retarded females which must pair with the less vigorous and less attractive males. So it will be if the more vigorous males select the more attractive, and at the same time healthy and vigorous females; and this will especially hold good if the male defends the female and aids in providing food for the young. The advantage thus gained by the more vigorous pair in rearing a larger number of offspring, has apparently sufficed to render sexual selection efficient."

Wallace was the first critic of the sexual selection theory. He admits that the display of gorgeous colors, the antics and songs of the male bird before the female, as fully demonstrated by Darwin but he says, "it by no means follows that slight difference in the shape, pattern, or colors of the ornamental plumes are what lead a female to give the preference to one male over another; still less that all the females of a species, or the great majority of them, over a wide area of country or for many successive generations prefer exactly the same modifications of colors or ornament." Thus he rules out the idea that the female makes a conscious choice of the male most highly colored or who is the best singer. But this does not destroy the idea that there may be an unconscious choice. Indeed, Wallace seems to admit this possibility when he says, "As all the evidence goes to show that, so far as female birds exercise any choice, it is of the most 'vigorous, defiant, and mettlesome' males, this form of sexual selection will act in the same direction (as natural selection), and help to carry on the process of plume development to its culmination." If this choice exercised by the female is unconscious rather than conscious, Darwin's theory is not vitally affected. All he is anxious to demonstrate is that the most vigorous bird succeeds in winning the most desirable mate, however the choice may be made, and if he succeeds in this the bird may pass to his offspring his own characters which in succeeding generations will become permanent.

But Wallace goes deeper in his criticism than the mere matter of choice. He attributes the origin of song to natural selection rather than to sexual selection. Darwin begins with sober colors

and attributes the gay colors of the males to selection on the part of the female. Wallace starts with the gorgeous colors and declares that the gray colors of the females are due to natural selection. Bright plumage would render the mother bird sitting on her nest conspicuous and make her the easy prey to hawks and other natural enemies. Hence all the highly colored females, through generations have been destroyed, only the more sober colored birds remaining. "The original brightness has been forfeited by the sex as a ransom for life. Female birds in open nests are similarly colored like their surroundings; while in those birds where the nests are domed or covered, the plumage is gay in both sexes."

The same principle of natural selection may be attributed to the call of birds. "These are evidently a valuable addition to the means of recognition of the two sexes, and are a further indication that the pairing season has arrived; and the production, intensification, and differentiation of these sounds and odours are clearly within the power of natural selection. The same remark will apply to the peculiar calls of birds, and even to the singing of the males. These may well have originated merely as a means of recognition between the two sexes of a species and as an invitation from the male to the female bird. When the individuals of a species are widely scattered, such a call must be of great importance in enabling pairing to take place as easily as possible and thus the clearness, loudness, and individuality of the song becomes a useful character, and therefore the subject of natural selection."

The increase and development of beautiful plumage is caused by the superabundant energy of the male bird. "During excitement and when the organism develops superabundant energy, many animals find it pleasurable to exercise their various muscles, often in fantastic ways, as seen in the gambols of kittens, lambs, and other young animals. But at the time of pairing male birds are in a state of the most perfect development, and possess an enormous store of vitality, and under the excitement of the sexual passion they perform strange antics or rapid flights, as much probably from the internal impulse to motion and exertion as with any desire to please their mates." So, also, "the act of singing is evidently a pleasurable one, and it probably serves as an outlet for superabundant nervous energy and excitement, just as dancing, singing, and field sports

do with us." If superabundant vigor can account for the songs and ornaments of birds "then no other mode of selection is needed to account for the presence of such ornament."

Brooks attacks the theory of Wallace that the duller colors of the female are acquired by natural selection. Thus there is found a difference in the colors of lizards where the female does not incubate and does not require the duller colors for the purpose of protection. In domestic fowl where danger from natural enemies is almost nothing the same difference in the color between the male and female continues. Thus the explanation is more fundamental than the one proposed by either Darwin or Wallace. Brooks bases his explanation upon a theory of heredity which supposes that the body gives off gemmules and that "the male reproductive cell has gradually acquired, as its special and distinctive function, a peculiar power to gather and store up these gemmules." The male cell, therefore, has acquired the power to transmit variation while the female cell keeps up the constancy of the species. "We thus look to the cells of the male body for the origin of most of the variations through which the species has attained its present organization." Darwin said that the plumage and song of the male bird were transmitted by the selection on the part of the female of the gayest bird and the best singer. Brooks goes deeper and finds the cause for these secondary sexual characteristics in the power of the male cell to transmit the variations. He does not deny that the female may choose the best singer but affirms that the male must lead in variations from his very nature.

Geddes and Thompson carry forward still further the criticism of Wallace and Brooks. Wallace accounts, on the theory of natural selection, for the dull colors of the female and for the more brilliant colors and song of the male. Darwin on the other hand rivets his attention upon the gorgeous colors, the plumes, combs and wattles of the male, accounting for them by the theory of sexual selection but fails to tell us why the same process does not brighten up the coat of the female. The mere statement of the position must make it clear that there is some deeper cause than that discovered by either Darwin or Wallace, some internal factor much more powerful in its operation than any external cause. Geddes and Thompson finds this in the essential difference be-

tween the sexes. "The females incline to passivity, the males to activity. The female cochineal insect "spends much of its life like a mere quiescent gall on the cactus plant. The male, on the other hand, in his adult stage is agile, restless, and shortlived." So with the other insects and other animals. The male is more active while the female is passive.

"For completeness of argument, two other facts may here be simply mentioned. (*a*) At the very threshold of sex-difference, we find that a little active cell or spore, unable to develop itself, unites in fatigue with a larger more quiescent individual. Here, at the very first is the contrast between male and female. (*b*) The same antithesis is seen, when we contrast the actively motile, minute, male element of most animals and many plants, with the larger passively quiescent female-cell or ovum.

"To the above contrast of general habit, two other items may be added, on which accurate observation is still unfortunately very restricted. In some cases the body temperature, which is an index to the pitch of life, is distinctly lower in the females, and has been noted in cases so widely separate as the human species, insects, and plants. In many cases, furthermore, the longevity of the female is much greater. Such a fact as that women pay lower insurance premiums than do men, is often popularly accounted for by their greater immunity from accident, but the greater normal longevity on which the actuary calculates, has, as we begin to see, a far deeper and constitutional explanation.

"The agility of males is not merely an adaptation to enable that sex to exercise its functions with relation to the other, but is a natural characteristic of the constitutional activity of maleness; and the small size of many male fishes is not an advantage at all, but simply again the result of the contrast between the more vegetative growth of the female and the costly activity of the male So brilliancy of colour, exhuberance of hair and feathers, activity of scent glands, and even the development of weapons, cannot be satisfactorily explained by sexual selection alone, for this is merely a secondary factor. In origin and continued development they are outcrops of a male as opposed to a female constitution. To sum up the position in a paradox, all secondary sexual characters are at bottom primary, and are expressions of the same general habit

of body (or to use the medical term, *diathesis*), as that which results in the production of male elements in the one case, or female elements in the other."

This essential difference between the two sexes which expresses itself in differences of plumage and song is further emphasized by the facts, first, that many of the secondary sexual characters appear only at sexual maturity. Thus some of the male birds are dull colored when young like the female and acquire the brighter colors only on full development. Again when the sex organs are removed by castration the male ornaments or weapons of battle disappear. In cattle castration reduces the size of the horns and after castration of the stag he never renews his antlers.

In the case of young cocks the effects of castration are very variable, sometimes increasing, sometimes decreasing the secondary sex characters. One result is clear, however, that the whole body is affected; the larynx is intermediate in size between that of cock and hen, the syrinx is weakly developed and the capons seldom crow or do so abnormally, the brain and heart are lighter in weight, fat accumulates in the subcutaneous and subserous connective tissues, and the skeleton shows many abnormalities.

The conclusion seems inevitable that neither Darwin nor Wallace reached the root of this matter. "The males are stronger, handsomer, or more emotional, simply because they are males, i. e. of more active physiological habit than their mates." This view does not wholly eliminate either natural or sexual selection. These may be limiting, and, in a sense, directive factors, but it is fundamentally the nature of sex which determines the gay color or the vigorous song.

To complete our review of this controversy which has been waged between ornithologists, we must record some of the more recent discussions of the Darwinian theory of sexual selection. Hudson says; "The result of such independent investigation will be a conviction that conscious sexual selection on the part of the female is not the cause of music and dancing performances in birds, nor of the brighter colors and ornaments that distinguish the male. It is true that the females of some species, both in the vertebrate and insect kingdoms, do exercise a preference; but in a vast majority of species the male takes the female he finds, or that he is

able to win from other competitors; and if we go to the reptile class we find that in the ophidian order, which excels in variety and richness of colour, there is no such thing as preferential mating; and if we go to the insect class, we find that in butterflies, which surpass all other creatures in their glorious beauty, the female gives herself up to the embrace of the first male that appears, or else is captured by the strongest male, just as she might be by a mantis or some other rapacious insect." He accounts for the singing of birds by the abounding energy of birds. "We see that the inferior animals, when the conditions of life are favorable, are subject to periodical fits of gladness, affecting them powerfully and standing out in vivid contrast to their ordinary temper. And we know what this feeling is — this periodic intense elation which even civilized man occasionally experiences when in perfect health, more especially when young. There are moments when he is mad with joy, when he cannot keep still, when his impulse is to sing and shout aloud and laugh at nothing, to run and leap and exert himself in some extravagant way. Among the heavier mammalians the feeling is manifested in loud noises, bellowings and screamings, and in lumbering, uncouth motions — throwing up heels, pretended panics, and ponderous mock battles."

This is simply a repetition of Herbert Spencer's surplus energy theory which was based on the earlier theory of Schiller who in his letters 'On the Æsthetic Education of Mankind' wrote: "Nature has indeed granted, even to the creature devoid of reason more than the mere necessities of existence, and into the darkness of animal life has allowed a gleam of freedom to penetrate here and there. When hunger no longer torments the lion, and no beast of prey appears for him to fight, then his unemployed power finds another outlet. He fills the wilderness with his wild roars and his exuberant strength spends itself in aimless activity. In the mere joy of existence, insects swarm in the sunshine, and it is certainly not always the cry of want that we hear in the melodious rhythm of bird songs. There is evidently freedom in these manifestations, but not freedom from all necessity. The animal works when some want is the motive of his activity, and plays when a superabundance of energy forms his motive when overflowing life itself urges him to action."

It is too superficial a theory to satisfy the modern mind. We are compelled to ask the question, why does the male bird have more surplus energy than the female? This question throws us back to a consideration of the fundamental difference between the male and the female. There is only one answer to that question. The male sings more vigorously because he is a male, in other words because there is some fundamental difference between the sexes.

Karl Groos has contributed one very serious modification of the Darwinian theory which has not been given sufficient consideration by ornithologists, namely, that the song and antics of the male bird are not for the purpose of compelling her choice by the female but to overcome and break down her instinctive coyness. Nature has given the female coyness as a dam to nature's impulses to prevent the "too early and too frequent yielding to the sexual impulse." A high degree of excitement is necessary to break this down and hence the necessity for all the vigorous songs and antics of the male.

I am confident that this theory is destined to find wider acceptance in the future than it has in the past, indeed, that a large part of the song of birds before the nesting season is for the purpose of breaking down the reluctance of the female rather than compelling her choice of a particular male. At Bakersfield, California, I spent an hour watching a male Flicker sitting on a small limb a foot or more above his mate while both birds went through motions that were interesting and at times almost ludicrous. The proud male would extend his head in a line with his body, then turn both body and neck first to one side and then the other, like a weather vane hung on a central shaft, at the same time jerking his head back and forth in a sort of kick-up motion, and pouring out all the time a quick succession of notes which might be represented by the words *pick-up, pick-up, pick-up,* closing the whole performance by a right-about-face, when he would rest a minute and repeat the process. His less gaily colored mate was not so vigorous in her antics as her proud lord nor did she indulge in them so frequently but it was evident that he was making his impression and she could not refrain from expressing her feelings. I was certain that these birds had mated their lives "for better, for worse." Hence the love song could not have been for the purpose of mating but to

furnish the necessary excitation to make productive the season that was at hand for the reproduction of their race. There is no other explanation that can be given for birds already mated, unless it be that of the overflow of superabundant energy and this is too superficial an explanation for the deep laid plans of mother nature. Were this the only cause for the songs and antics of birds the mere overflow of nature might never terminate in anything or it might lead to unregulated abuse. But nature protects and regulates her ways by safety valves, of which the reluctance of the female is one, and this must be overcome before the reproductive process can become effective.

This view seems to be strengthened by the fact that the display of song and antics is used by polygamous birds and animals as well as by those which mate for the season or for life. The rooster with his harem about the barnyard is just as vigorous in his performances as the bird which is devoted to his single mate. The doe in her breeding time calls to the buck who rushes to her side, then she, "half in coyness, half in mischief, takes to flight at his eager approach, makes towards an open space, and runs in a circle. The buck naturally follows, and the chase grows hot and exciting as a race of horses on a track. To the frequent high calls of the fleeing doe are added the deep, short cries of the panting buck; but suddenly the roguish doe disappears like a nymph into the thicket near at hand, and the baffled buck stands with head erect and ears thrown forward; then we see his head lowered as he catches the scent, and he too vanishes in the wood." But this deer is a polygamist and his antics cannot be for the purpose of mating.

Watch the finch as he dances about his mate, fairly losing himself in a frenzy of ecstasy, flashing his wings in a wild delight and prancing about and chattering, the antics of the noisy street sparrow, the prancing and cooing of the pigeons, and there is only one evident conclusion. It is not for the purpose of mating but the more immediate purpose of hastening the female to fulfill her natural function. There are times when two or more males are involved in these antics, in which case there must be at least an unconscious choice on the part of the female, or a battle royal which will drive the competing males away, but in the vast majority

of cases there is only one ardent male bird in the presence of the female and he is often the bird with which she has already mated.

A weakness of the sexual selection theory that has not been given sufficient consideration is that the song of birds has been treated too exclusively in connection with the mating season. Men have riveted their attention on those rapturous bursts of song which precede and continue through the mating time, and have given too little attention to the fact that few birds are ever wholly voiceless, that most birds speak the sign or voice language, at least to some extent, all through the year.

Most of our best singers have two distinct song periods. One begins with the arrival of the advance guards of the migrating hosts and continues until the broods of young birds are hatched. When the young birds have left the nest and are able to care for themselves there is a cessation of the full, joyous songs, September being generally the silent month. Then many of the birds begin to sing the last of September or the first of October and continue until November. Bicknell has determined definitely the limits of these song periods for many of our birds. The House Wren begins to sing its love song in April and continues to the last of July or the first of August. After a period of comparative silence it begins its autumn song which has none of the spontaneity of the spring song but consists of a "low rambling warble" which continues to the middle of October. The Black and White Creeping Warbler sings from April to the late June. Its second period begins from the ninth to the twenty-second of August and lasts only a few days. The first period of the Oven-bird stops by the end of June. The second period begins in August, at first haltingly, as though it had forgotten how to sing, but finally bursts into full song by October. The Wood Thrush sings from its arrival in late April or early May until the middle of August. It is not heard again until October and then only the call notes, never the full song.

Bicknell attributes this period of silence to the moult of the bird. In many cases the moulting periods of our song-birds correspond more or less closely with periods of silence, voice being renewed with the renewal of plumage. The general statement may therefore be made, that birds are predisposed towards silence during the height of the moult. Though this fact may by many be regarded

as one not requiring demonstration, it is by no means without exceptions. In the earlier and later stages of the moult the vigor of the birds in general seems little impaired. Not only do many species enter on their migrations while yet the moult is in progress or before the complete maturity of their renewal plumage but birds may be found sitting upon their eggs with evident indications of activity on the growth of feathers. Still we must regard it as a general fact that singing and moulting are in some degree complementary.

Some birds have no second song period. The Catbird sings from April through July but it is not heard in the autumn. The Brown Thrasher sings from April to the first week in July but is silent in October. After August the Scarlet Tanager is not heard again in full song. Where this second period is lacking it is probably due to the excessive fatness of the bird. Thus the Scarlet Tanager undergoes its moult in August. The growth of the new feathers continues until October when the bird becomes very fat. The Wood Thrush moults in August but is not fat. By the last of September its plumage is nearly perfect and the bird is fat. Hence the song seems to be interrupted first by the moult and then by the adipose condition.

There are some cases where the birds' best song is outside of the mating season. It is a significant fact that the male birds arrive first in the migration and soon after their arrival begin their full song though there are no females to hear. It may be said this is for the purpose of attracting the females on their arrival or that the male is practising his art but this seems too superficial an explanation. There must be something within the bird himself which causes him to sing though there is no ear to listen. Hudson calls attention to a small yellow field finch of La Plata which does its best singing in August. There birds gather in great flocks in the tops of trees and sing in concert, producing a "great volume of sound, as of a high wind when heard at a distance." Later this choir breaks up, love infects the individuals, and they scatter over fields and pasture lands. But during courtship the male has only a feeble, sketchy song.

There are birds which sing more or less the entire year. Hudson found several birds in Patagonia with good voices, one a mocking-

bird, which were autumn and winter songsters. Olive Thorne Miller tells of a Gray-checked Thrush in captivity which sang all winter. "All through the long winter this charming thrush, with his two neighbors delighted the house with his peculiar and matchless music, and endeared himself by his gentle and lovely disposition. No harsh sound was ever heard from him, there was no intrusion upon the rights of others, and no vulgar quarrels disturbed his serene soul." (In Nesting Time, pp. 168–169.) The voice of the Crow is as vigorous in January as in June and while I write these lines, in February, a Blue Jay is screaming from a tree in a neighbor's yard as though April had come. The Chickadee sends out his cheery song the coldest day in winter with almost as much vim as he does in the nesting time. The metallic notes of the Flicker ring over the hill sides through the coldest months with a vigor becoming the hardy bird. Indeed, the man who goes forth into the New England hills in winter, especially if the sun happens to be shining brightly, must be impressed by the number of bird notes he will hear during the day. I went forth one day in January when the earth was encased in ice, over which was a thin layer of fluffy snow. A strong wind was blowing, whipping the bare branches of the trees. The thermometer was low and the air stinging, surely as unfavorable a day as one could find for birds. What was my delight to find a large flock of Robins and another of Goldfinches. The latter were as active and cheerful as though it had been a day in May. Defying the wind, they were in the tree tops, swinging on the tips of the branches, sometimes hanging up side down, hunting eagerly for food. And from the tops of the trees their sweet, unobtrusive notes dropped down like bubbles of melody floating leisurely through the air. They were such a friendly company, no one showing jealousy because another had been more fortunate in finding food. Their concert of song was a free expression of their genial disposition, some birds uttering only single notes while others rolled out three or four syllables. I never heard a more hearty Goldfinch chorus in the spring than they uttered on this cold January day, except it was not quite so loud as in April. The Robins showed more effect of the cold weather, sitting on a branch with their feathers fluffed out, as though to increase the size of their feather coat, but with all their discomfort

they too indulged in song. Most of them gave the single Robin note but occasionally a more ambitious bird would roll out a longer phrase, one bird answering another that called from a distant tree. Then the entire flock would rise on wing, chirping as they flew, as though glad they were living and could not withhold an expression of their joy. From the top of the pines the Crows cawed at each other, tipping their bodies as they called in a tilting motion, and protruding their necks and heads with each note.

The fact that is too seldom taken into consideration is that while the bird usually sings his most vigorous song and indulges in his most frantic efforts around the nesting season, he does use his voice at other times during the year, that there are few birds that are entirely voiceless at any time. Sometimes he utters only a call note, again the note of alarm, caused by sudden flight, while again he sings apparently only for the pure joy of living. But throughout each month of the year either a sign or spoken language plays a part in the ceremony of his existence. His song is not merely a thing related to his sexual life. It has a relationship to his total existence. It is no more to be explained by the principle of sexual selection than is the existence of the human voice, even in its higher and finer modulation, by the same law. It is the means by which the bird expresses himself to the outer world. It is used according to the need of the hour or the season, the instrument by which the bird communicates his needs or feelings.

It is significant in this connection that so little has been said concerning the voice of the female. The question may reasonably be raised whether her voice is not much more important in nature's scheme than that of the male. He is a much more ardent, vigorous and accomplished singer. But after all that can be said about his song the fact remains that it is not so very important. It is a sort of grandstand performance. He is a sort of trobadour who comes forth to please those who hear but it contributes nothing we can see toward the protection or rearing of the young. But who that has listened to the sweet, low notes of the mother to her young or the alarm notes or clucks which cause her helpless brood to run to hiding, can doubt that the voice of this female is very important in the struggle for existence. If the purpose of selection is the improvement of the race why might not some genius show that

the males select the mate with the best cluck or call for the protection of her brood? It would certainly be a theory far more in harmony with nature's plans. But, while no person would probably have the courage to prove such a theory, it cannot be doubted that the female has a language and that it is far more important in the preservation of the race than the more modulated language of the male.

All of these facts must be taken into consideration before we can adequately account for the song of birds. The sexual selection theory is based too exclusively upon one period in the bird's life. The bird has more than one season of song and there is no month of the year when his voice does not play some part in his life. The female has a language as well as the male. It must be evident that any explanation which will be adequate to account for bird language must cover every season and must be found in the inner life of the bird rather than in outward circumstances or choices.

Again there are certain types of sign language which are much more universal among birds than has generally been assumed. Much emphasis has been placed upon the displays and love dances of pheasants and birds of paradise which, it has been assumed, was the cause of the beautiful plumage of these birds. The female choosing the best performer or the most highly colored male has resulted through slight modification, generation after generation, in these elaborate decorations. But we have, since Darwin, discovered that the love dance or display is in some measure used by many birds, often birds of dull color, like the English Sparrow, and they are still, in spite of the love dance, dressed in gay or sober plumage. Howard, in his remarkable 'History of the British Warblers,' has shown "that these birds of sober hues perform during moments of sexual exaltation, antics which in every way reflect the display supposed to be peculiar to birds of brilliant plumage." Savi's Warbler, also, indulges in these antics even when feeding his young. Furthermore, these dances are not confined to the period of courtship.

From whatever point of view we approach this subject the evidence is so strong that we are compelled to look for our explanation in the internal life of the bird rather than in any external, exciting cause. Most of the theories thus far set forth have in

them an element of truth. If the purpose of song is excitation of the female to break down her coyness, this very act may compel her to exercise an unconscious choice and thus sexual selection may exert a limiting and directive force in the life of the bird. Even Hudson's theory that the bird sings out of the abundance of its very being, joy and life, is not to be ignored. But the question forces itself upon us, why does the bird sing and dance to overcome the female coyness and what gives the male more vitality than the female? The answers to these questions force us back into the inner life of the bird to seek our answer in the essential difference between the sexes.

So far as song, as well as other displays, in the mating season are concerned they are due to the ripening of the sexual glands from which, as Pycraft has shown, hormones "are set free, and, pervading the body, stimulate the nervous system, and at the same time the secondary sexual characters — the antlers of the stag, the mammary glands of the female, the 'breeding plumage' of the bird. When they are obviously secondary sexual characters, as in the case of dull colored birds, the result is the same, a state of physical exaltation expressed in 'display.' Males or females wherein these 'hormones' are but feebly developed, display and respond indifferently, and so cease to please the opposite sex. As Mr. Howard has pointed out, in the case of the Warblers, no amount of display on the part of the male will avail until the female has attained a like pitch of preparedness for the work of procreation. The courtship of the ruffs and reeves, already referred to, afford another illustration. Here it will be remembered the males for weeks spend laborious days in endeavoring to gain some responsive sign from their prospective but phlegmatic mates, yet without receiving the slightest sign of encouragement or recognition. As soon, however, as the female has become 'sexually ripe,' as soon as the hormones secreted by her generative glands have done their work, she herself indulges in a species of nuptial dance, waltzing round her lord, and setting down before him with her tail directed toward his head. Thus the sexual activity displayed by the male comes to mean simply that he is more ardent at this time than his mate. The advantage of this is obvious: for thereby the more vigorous males, by proclaiming their desire to pair, defeat their

less vigorous rivals, who might otherwise be chosen. The earlier they can take the field, the more persistent their advances, the greater their chance of ultimate success, and this because they slowly instil a preference which cannot be overcome by later and less virile comers."

This fact makes it clear why many of the sober tinted birds are as ardent in their love dances and displays as some of the more brilliantly colored birds like the peacock and the pheasant. It may also explain why some of the more beautifully colored birds sing as vigorously as the duller tinted species. Their nervous system is in a condition of intense stimulation through the action of secretions thrown off by the sex glands. But the important fact is that it completely modifies the theory of sexual selection, so modifying it that there is little of the significance attributed to it by Darwin and his followers remaining. The antics, display and songs of birds are germinal variations which have survived and are not the result of conscious or unconscious choice on the part of the female. This is "borne out by the fact that birds of the most sober hues affect displays of a character precisely similar in kind to those of birds in which this display appears to be made for the sole purpose of exhibiting to the best advantage some specially modified or beautiful colored feathers."

This view which seeks the cause of song in the internal life of the bird rather than in external causes, also gives a more satisfactory view of the total language of the bird, the call and alarm notes, the gentle notes of the mother bird over her young and the songs that are uttered outside of the mating season. The sexual selection theory has fallen down, in my judgment, from the fact that it has confined itself too exclusively with one short period in the language of the bird. It has failed almost exclusively to recognize that birds have a language which extends throughout the entire year, either sign or tone language, and that there must be something in the feathered creature which will account for this less vigorous expression of life and needs which occur outside of the mating season. It is here that the theory of germinal variations comes to our assistance. Voice having originated in the hisses and groans of the reptile, it was inevitable that there should be a difference both of tone and vigor between the male and female

birds, due to the essential difference of sex and any variations in voice which might arise would be preserved in the male germ which assures the variation in the species while the germ of the female guarantees the constancy of the species.

SOME ADDITIONS AND OTHER RECORDS NEW TO THE ORNITHOLOGY OF SOUTH CAROLINA.

BY ARTHUR T. WAYNE.

SINCE 'My Birds of South Carolina' was published in 1910, I wish to announce the addition of four species new to the fauna as well as the noteworthy capture of many birds, and the early breeding of Bachman's Warbler. Information of this kind is gained slowly, and requires constant, if not daily, exploration of fields, forests, and water areas.

Puffinus griseus. SOOTY SHEARWATER.— A specimen of this species was picked up dead on the beach of Bull's Island on, or about, the last of May, 1916, by Mr. Clarence Magwood. I examined the bird about a week after it was found. This date probably represents the time when the birds make their appearance in the spring on the South Carolina coast.

Histrionicus histrionicus. HARLEQUIN DUCK.— During the intensely cold weather which began on December 30, 1917, and continued through the third week of January, 1918, I was constantly on the lookout for far northern birds. On January 14, I saw four of these ducks, and on the 16th, I saw two more near the place where the first were seen on January 14. These ducks were probably not more than 75 or 80 yards from me and the identification was established without a doubt despite the fact that I was unable to shoot one. All the examples were in the plumage of the female and must have been that sex or else young males of the first winter plumage. Near at hand were small flocks of Buffle-head (*Charitonetta albeola*), Old-squaw (*Harelda hyemalis*), and Ruddy Ducks (*Erismatura jamaicensis*), and the Harlequin's were easily identified. This is an addition to the avifauna of South Carolina.

Chen hyperboreus hyperboreus. SNOW GOOSE.— On October 16, 1916, Mr. Lucian L. Porcher shot on Porcher's plantation, Christ Church